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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY.—BULLETIN NO. 91.

A. D. MELVIN, CHIEF OF BUREAU.

M. E. J. [Signature]

FEEDING PRICKLY PEAR TO STOCK IN TEXAS.

BY

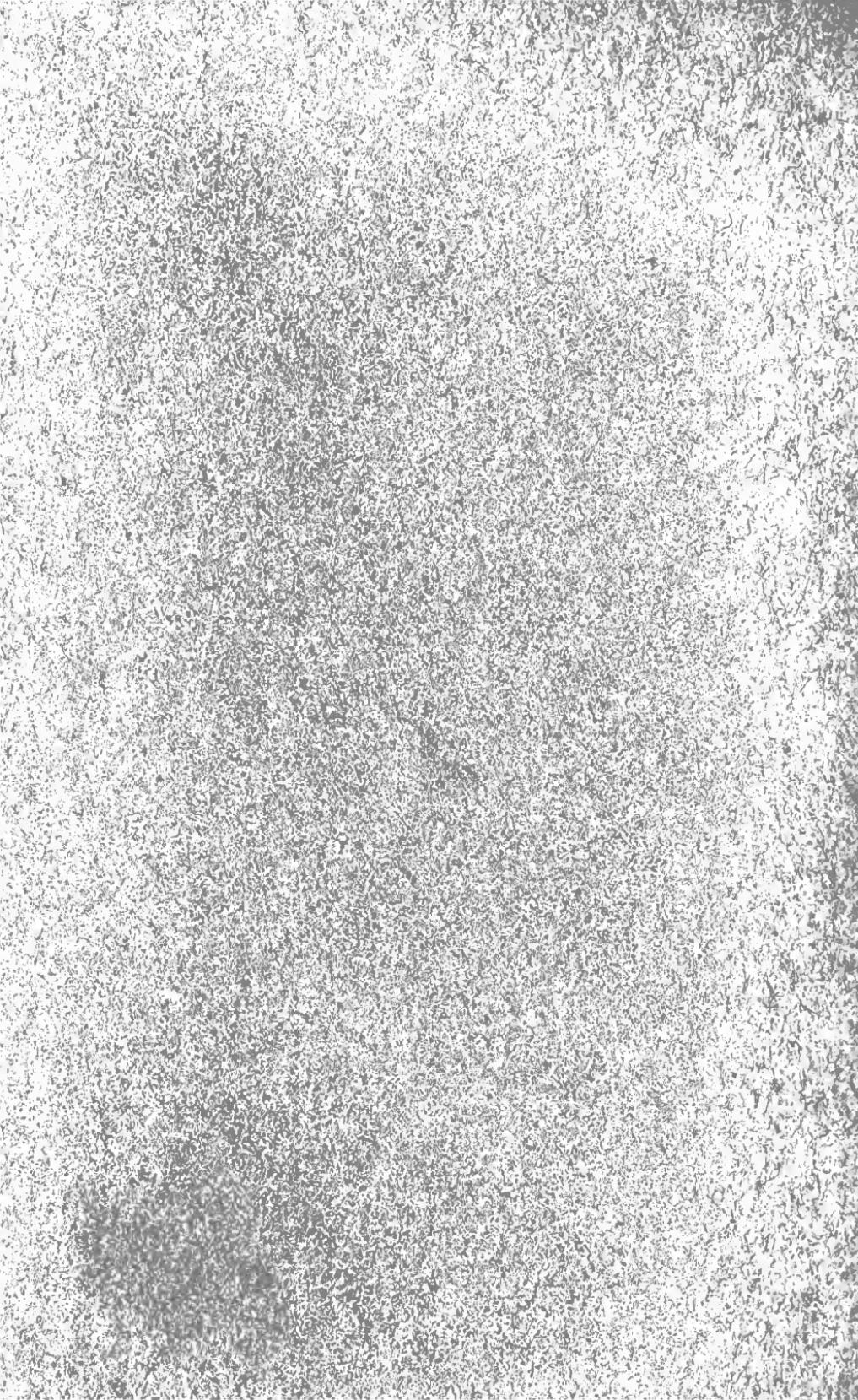
DAVID GRIFFITHS,

*Assistant in Charge of Range and Cactus Investigations, Farm Management
Investigations, Bureau of Plant Industry.*



WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 28, 1906.

SIR: I have the honor to transmit herewith and to recommend for publication as a bulletin of this Bureau a manuscript entitled "Feeding Prickly Pear to Stock in Texas," by David Griffiths, assistant in charge of Range and Cactus Investigations, Farm Management Investigations, Bureau of Plant Industry. The accompanying letter from the Chief of the Bureau of Plant Industry explains why, although the work was done under the supervision of that Bureau, it seems desirable to publish the paper as a bulletin of the Bureau of Animal Industry.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., July 5, 1906.

SIR: I have the pleasure to transmit the manuscript of a paper entitled "Feeding Prickly Pear to Stock in Texas," and recommend that it be published as a bulletin of the series of your Bureau. The investigations reported here are necessarily dual in character and deal with a subject partially within the province of investigation of both bureaus. It is a subject upon which we needed more information before proceeding further with investigations into the value of various species of cacti as farm and range crops. Inasmuch as the paper deals primarily with the animal side of the subject, I submit it to you for publication.

The paper was prepared by Dr. David Griffiths, assistant in charge of Range and Cactus Investigations, and has been submitted by the agriculturist in charge of Farm Management Investigations with a view to its publication. It is a continuation of Bulletin No. 74 of the Bureau of Plant Industry, which gives an account of the practice of stockmen in the use of cacti as forage plants, particularly in southwest Texas, where most of the cactus is fed.

The present paper gives an account of some experiments conducted by stockmen at the suggestion and under the direction of this Bureau. The results of these experiments are of unusual interest. The experiment with dairy cows was made in such a manner as to compare the cactus directly with sorghum hay. The two animals under experiment were fed at the beginning both cactus and sorghum. Their feed was then gradually changed to cactus. Afterwards one of them continued to receive cactus, while the other was changed gradually to sorghum hay. After a period of such feeding the feeds were gradually interchanged. During the whole of this test both cows were fed a mixed grain ration in addition to the roughage.

Generally speaking, the results indicate that cactus ad libitum produces a little better results in milk flow than sorghum hay ad libitum, both with sufficient grain, though the differences are small.

The results indicate that 6 pounds of fresh cactus are equivalent in feeding value to 1 pound of dry sorghum hay. The test with beef cattle was undertaken to ascertain the cost of fattening cattle on cactus and cotton-seed meal, a common practice in the region where the cactus is mostly fed. The carload of steers used in the test made only moderate gains, averaging $1\frac{1}{4}$ pounds daily for each head during the fattening period. The very interesting result was obtained, however, that this gain was made at a cost of a little less than $3\frac{1}{2}$ cents a pound.

In both cases the results indicate that stockmen are justified in making use of cactus as an efficient and cheap source of nutriment for cattle.

Further studies of cacti, including a large number of chemical analyses from a feed-stuff standpoint, are nearly completed, and the results will be ready for publication in the near future.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Dr. A. D. MELVIN,

Chief, Bureau of Animal Industry.

P R E F A C E .

The evident value of prickly pear as a forage, judging by the experience of many who have fed this material, the urgent demand for information concerning it, and the lack of experimental data from which a reasonable estimate of the food value can be made, rendered experimental feeding highly desirable. The difficulties in conducting such an experiment were manifold. In the first place, it was highly desirable that the cattle used should be accustomed to the feed. The only section of the country in which such cattle could be found was far removed from any experiment station. Trained experimenters who were familiar with cactus feeding were wholly wanting. Fortunately, however, a number of persons who had fed cactus for many years in southwest Texas appreciated fully the value of the information sought and were willing not only to furnish the cattle and provide the feed, but to attend to the details of the feeding and weighing.

In the experiment with dairy cows conditions were such that it was impossible to feed more than two cows experimentally. Yet a careful inspection of the results show that the care with which Mr. Sinclair carried out the details of the work renders the results of great value as an indication of the possible value of prickly pear as a feed for dairy cows. It is shown that a ration producing between $1\frac{1}{4}$ and $1\frac{1}{2}$ pounds of butter a day cost in the neighborhood of 13 cents when pear, rice bran, and cotton-seed meal was fed.

Although prickly pear is low in nutritive value from the chemical standpoint, the steer-feeding experiment also shows that there is abundant justification of the practices in vogue of preparing cattle for market upon prickly pear and cotton-seed meal. A gain of $1\frac{3}{4}$ pounds a day at an expense of $3\frac{1}{2}$ cents a pound compares very favorably with feeding results obtained with standard feeds.

W. J. SPILLMAN,

Agriculturist in Charge of Farm Management Investigations.

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CONTENTS.

	Page
Introduction	9
The pear fed	9
Prickly pear in the ration of dairy cows	11
Conditions of the experiment	11
Method of feeding	12
Feeding periods	12
Daily record for Period I	14
Daily record for Period IV	14
Comparison of different periods	15
Cost of feed	16
Peculiarities noted in feeding	17
Condition of the animals	17
Influence of pear on quality of milk	18
Prickly pear in ration of beef cattle	18
Conditions of the experiment	18
Method of feeding	19
Weighing	19
Shipment and sale of steers	20
The feeds used	20
General observations	20
The nature of chopped pear	22

ILLUSTRATIONS.

PLATES.

	Page.
1. Cows used in the milking test.....	12
2. Fig. 1.—Some of the beef cattle used in the feeding experiments. Fig. 2.— Field of prickly pear on the Sinclair ranch.....	16
3. Fig. 1.—Machinery ready to chop pear. Fig. 2.—Chopped pear ready for feeding.....	20

TEXT FIGURE.

1. Diagram showing average yield of milk of cows Nos. 12 and 13 during periods I, II, III, and IV.....	15
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FEEDING PRICKLY PEAR TO STOCK IN TEXAS.

INTRODUCTION.

Bulletin No. 74 of the Bureau of Plant Industry suggested in a brief, popular way some of the more important features of the problem of utilizing cacti as feed for live stock. The present paper is a continuation of that publication, designed to furnish information upon one feature of the problem treated but slightly in the bulletin mentioned.

In the data here presented the aim has been to secure a record of the value of pear as commonly fed. It has not been the main purpose to determine the best methods of feeding this forage plant. In the experiments outlined the endeavor was made to change current practice no more than was necessary to secure the essential data. To determine accurately the value of prickly pear as a dairy or fattening ration would require more elaborate experiments. It has been the aim to give here simply a record of what the rancher realizes from his pear by the ordinary methods of feeding, though such other data as the records have revealed have been noted.

Two experiments are outlined, both conducted under the immediate supervision of ranchers in southern Texas in cooperation with the Bureau of Plant Industry. The first test was undertaken by Mr. Alexander Sinclair, of San Antonio, to whom the greatest credit is due, not only for the conduct of the work but also for assistance in planning the experiments and for suggestions in connection with the interpretation of results. The actual work was performed under his immediate direction by his son, Mr. William Sinclair. The second test was conducted by Mr. T. A. Coleman upon his ranch at Encinal. The feeding was done under Mr. Coleman's immediate supervision, and to his interest and varied experience is due whatever success has been attained.

THE PEAR FED.

There is such confusion in the scientific disposition of the prickly pears that it seems almost hazardous to venture an opinion regarding the proper names of even such common and conspicuous species as those of southern Texas. After studying the forms for two years,

however, the writer believes that he can readily determine all the species growing in the region and fed in these experiments. There is, however, such variation in the limitation of the species considered in these pages that it may be advisable to note more than one species in what is here called *Opuntia lindheimeri* Engelm.

There are usually recognized in this region two species of prickly pear, known, respectively, as *Opuntia macrorhiza* Engelm.^a and *Opuntia lindheimeri* Engelm. The former is a small, prostrate, usually tuberous-rooted species, of no special economic importance. The latter has at least two forms more or less distinct, one with yellow spines and the other with spines red or brown at the base. The yellow-spined form is the typical *Opuntia lindheimeri*, as originally described by Doctor Englemann, and the latter corresponds more closely with what was originally named *Opuntia engelmannii* Salm, although it differs considerably from the typical form^b of that species as it occurs in the type locality in northern Chihuahua. Both of these forms are at present considered by a majority of botanists to be the same species.

Besides these, there is a form which has also been included under *Opuntia lindheimeri* having spines reddish-brown throughout, with joints somewhat smaller and less prolific at least in a state of nature. This form is also less thorny on the average than the larger-jointed yellow-spined variety, and forms a large part of what is popularly called "blue pear" in southern Texas. However, all blue pear does not have brown spines, for the smoother and more glaucous forms of the yellow-spined variety are also included under this name. All of these forms—those with yellow spines, with brown spines, and with yellow spines brown at the base—have fruits which are normally reddish-purple throughout; but there is a yellow-spined form having green fruits, tinged with purple outside and greenish-yellow within; its seeds also differ very radically from what we consider typical for the species, being about twice as large, the difference in size being made up very largely in the margin. This form is not to be distinguished in any way from the typical yellow-spined form by any habit, spine, or spicule character. Notwithstanding the fact that reproductive characters are supposed to be reasonably constant, the inclination is to consider this also a variety of *Opuntia lindheimeri*.

^a It seems better to retain this name until such time as the synonymy of the group can be satisfactorily determined. There is no doubt that the plant in question is the one to which the name was originally applied.

^b Type specimens when they become old yield but little information regarding the color of the spines, for after being preserved for some time all the spines turn black. This is true of the types of *Opuntia lindheimeri* which have been examined in the herbarium of the Missouri Botanical Garden. Accurate conceptions of these features must therefore be secured by a study of living plants in the type localities.

In addition to those mentioned, there is a distinct species which it is believed has not heretofore been recognized by botanists. This is common south and east of Cotulla, Tex., and consequently is found growing in the Encinal region, where one of the experiments was conducted. It is very distinct from the species previously mentioned, with which it is always associated. It is different in general appearance, as well as in its more strictly botanical characters, being the tallest, most woody, and most loosely branched of the prickly pears of southern Texas. It is characterized by circular joints and by single, erect, long, straw-colored, translucent, bonelike spines, which occasionally have a tinge of red at the base. It blooms and matures its fruit four to six weeks later than the forms of *Opuntia lindheimeri*, the most common of the Texas pears, and its fruit is smaller and more nearly globular. This plant is almost universally known among the Mexican population of this section as "caca napa." It will doubtless be described as a new species, in which case it would be advisable to use "caca napa" as the specific name.

All of these forms included under *Opuntia lindheimeri* were used in these experiments, the yellow-spined or typical one predominating in the rations. More of the brown-spined form was fed at Encinal than at San Antonio, although considerable of it was fed at the latter place. At Encinal some caca napa was fed, but probably not more than 1 or 2 per cent of the ration.

PRICKLY PEAR IN RATION OF DAIRY COWS.

CONDITIONS OF THE EXPERIMENT.

The two cows selected for the experiment were secured from Mr. Sinclair's herd of about 100 head. As it was desirable to have gentle cattle, the selection was made especially with this point in view. They were, however, typical specimens of the herd in other respects and were known upon the ranch as Nos. 12 and 13. They are both Holstein-Jersey stock. In No. 12 Holstein characters predominated decidedly, while in No. 13 Jersey characteristics were more prominent. No. 13 was 6 years old and dropped calf November 27; No. 12 was 7 years old and dropped calf December 6. They were thoroughly accustomed to pear pastures and had been fed singed pear for two to four months each winter. (See pl. 1.)

During the feeding period the cows were kept in separate sheds, opening to the east into small pens about 10 yards square. There were feeding troughs in the sheds and a constant supply of water was kept in the pens. On the whole the sheds were a little more exposed than the barn where the general herd was kept, but the herd was turned out every night except during the coldest weather, while the test cows had their choice of shed or pen.

To accustom the animals to their new quarters they were removed from the herd and put in these pens one week before record keeping was begun. They were perfectly contented from the start. In order to secure uniformity the same person did the milking during the entire experiment.

METHOD OF FEEDING.

The pear was singed in the field with a gasoline torch (see pl. 2, fig. 2), cut and hauled to the barnyard, and unloaded in a pile on the barn floor, from which it was fed as desired. A load was sufficient for a week or ten days. This method kept the pear at a lower, more uniform temperature, no doubt, than that which was fed to the remainder of the herd. The pear in the building during the prolonged cold weather in January did not heat up during the day as much as that standing in the field. The difference, however, was very slight, except during the coldest weather indicated in the tables, when the pear kept indoors was frozen from twenty-four to forty-eight hours longer than that in the field. Each feed was weighed separately at the time of feeding.

At feeding time the material was placed in a box and chopped with a spade into pieces of a convenient size for the animals to eat, usually the equivalent to 2 or 3 inches square. The grain was invariably fed at milking time, and a ration of roughage consisting of pear or sorghum hay, or both, was fed three times each day. Pear was always fed after milking morning and evening, and about midday. It was the purpose during the entire period to feed all the pear the cows would eat, with a definite ration of grain and hay, or of grain alone. There was consequently some pear left in the boxes each morning. This was always cleaned out and deducted from the previous day's ration. It is usual when feeding for beef to sprinkle the meal over the chopped pear, but this could not be done here, for it was the purpose to get as much information as possible regarding the quantity of pear which the animals would consume with a definite grain and hay ration, or without the latter. The meal could not, therefore, be fed with the pear on account of the waste which would occur and the indefinite character of the results so far as the quantity of grain fed was concerned.

FEEDING PERIODS.

The first period covered twenty days, beginning January 25 and ending February 13. During this period the cows were fed, as they had been during the forty-seven days immediately preceding the experiment, rations consisting of rice bran, cotton-seed meal, a small feed of sorghum hay, and all the prickly pear they would eat. During the next four days the sorghum hay was gradually reduced so that by



FIG. 1.—Cow No. 12.



FIG. 2.—Cow No. 13.

COWS USED IN THE MILKING TEST.

Photographed February 22, 1905.

February 18, when the second period began, cactus formed the only roughage fed. Period II extended over eighteen days. During the twelve days immediately following Period II the roughage fed cow No. 12 was gradually changed from cactus to sorghum hay, so that during the third period of the experiment, which lasted fourteen days, the roughage fed cow No. 12 consisted entirely of sorghum hay, while that fed cow No. 13 consisted entirely of cactus. During the seven days between Periods III and IV the roughage of each cow was completely changed, in the case of one from sorghum hay to cactus, and in the other from cactus to sorghum hay. Period IV lasted fifteen days.

It will be noted that these cows at the close of the first period of this experiment had been fed without change of ration for sixty-seven days. During the experiment the roughage fed each cow was changed first to cactus alone, and then to sorghum hay alone. In the case of cow No. 12 the roughage was changed back to cactus alone during the last period. It is notable that the normal milk flow was hardly interrupted during the whole experiment and that the yield of milk was satisfactory throughout, except for a slight decrease just at the close of Period I, evidently due to unusually cold weather.

In the following tabular statements it has been thought wise, since the data are available, to include the daily record for Periods I and IV, inasmuch as this is, we believe, the first published account of pear-feeding data. Ordinarily one period would be sufficient for this, but two are included on account of the excessively low temperatures of late January and early February, introducing variations which would not ordinarily occur. Since the excessively low temperatures influenced results so materially, the United States Weather Bureau observations at San Antonio are incorporated up to February 13, 1905, for convenient reference in interpreting the decrease in milk flow during the first two or three weeks of the experiment.

DAILY RECORD FOR PERIOD I.

During this period the cows were upon the same feed they had been accustomed to at this time of the year. They had been fed this ration since December 9. Besides the feed tabulated below, cow No. 12 got 12 pounds of rice bran and 3 pounds of cotton-seed meal, with the exception of the last two days of the period, when she would eat only 11 pounds of rice bran. Cow No. 13 was started in at 12 pounds of rice bran and 3 pounds of cotton-seed meal, but the rice bran was decreased to 10 pounds on January 28 and to 8 pounds on February 6, because 8 pounds of rice bran was all that she would clean up. It was the purpose to feed all the sorghum hay and pear that the cows would eat during this period.

Date.	Yield of milk.		Butter fat in milk.				Amount of roughage fed.				Atmos- pheric tempera- ture.	
			Per cent.		Amount.		Prickly pear.		Sorghum.			
	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Maxi- mum.	Min- imum.
1905.												
January 25.....	Lbs.	Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	° F.	° F.
January 25.....	38.0	33.0			3.8	4.0	4.28	3.78	60	62	12	15
January 26.....	37.0	30.0					86	90	10	10	10	41
January 27.....	37.5	31.5					101	101	10	10	10	45
January 28.....	40.0	32.5					116	116	8	8	8	43
January 29.....	43.0	32.5	3.6	4.0			125	125	8	8	8	44
January 30.....	40.6	33.0					125	125	8	5	5	52
January 31.....	39.9	31.8					135	130	8	5	5	45
February 1.....	41.2	33.3	3.6	4.0	8.75	3.76	138	137	8	4	4	58
February 2.....	38.5	28.9					142	139	8	5	5	34
February 3.....	38.6	29.1					139	149	8	5	5	33
February 4.....	36.4	27.3					81	88	8	5	5	27
February 5.....	34.6	25.9	3.8	4.2	5.53	4.52	103	105	8	5	5	41
February 6.....	35.9	25.3					117	138	8	5	5	32
February 7.....	36.5	26.8					113	139	8	5	5	34
February 8.....	38.5	29.5					118	133	8	2	2	60
February 9.....	38.8	29.8	3.9	4.2	5.83	4.88	98	124	8	3	3	61
February 10.....	35.7	30.3					89	109	8	3	3	37
February 11.....	37.0	31.0					100	114	8	4	4	56
February 12.....	33.8	27.5	4.2	4.3	4.3	3.54	89	96	8	5	5	53
February 13.....	a 31.9	a 24.0					90	92	b 12	b 12	35	13

^a The rapid decrease in milk flow toward the close of this period is doubtless due to the unusually low temperatures.

^b Extra sorghum hay fed on account of frozen pear.

DAILY RECORD FOR PERIOD IV.

Period IV covered 15 days, with cow No. 12 receiving all the pear and cow No. 13 all the sorghum hay they would eat. Cow No. 12 received 12 pounds rice bran and 3 pounds cotton-seed meal and cow No. 13, 8 pounds rice bran and 3 pounds cotton-seed meal.

Date.	Yield of milk.		Butter fat in milk.				Amount of roughage fed.					
			Per cent.		Amount.		Prickly pear.		Sorghum.			
	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.	Cow No. 12.	Cow No. 13.
1905.												
April 10.....	Lbs.	Lbs.					Lbs.	Lbs.	Lbs.	Lbs.		19
April 11.....	33.6	27.7			3.6	3.8	2.49	1.98	141	149		26
April 12.....	35.7	24.4					1.39	1.11	150			23
April 13.....	36.8	28.6	3.8	3.9	3.2	3.2	.90	.90	160			22
April 14.....	36.2	28.4	3.4	3.4	3.2	3.6	1.15	1.00	165			22
April 15.....	36.0	27.8	3.2	3.2	3.6	3.6	1.00		119			21
April 16.....	32.6	27.5	3.6	3.8	3.8	3.8	1.17	1.04				23
April 17.....	32.4	28.4					1.16		a 99			23
April 18.....	30.3	27.0	3.6	4.2			1.09	3.47	120			25
April 19.....	31.1	27.4					1.11		116			23
April 20.....	31.6	27.5					1.26		143			25
April 21.....	33.9	29.4	4.0	3.8			1.35	3.19	158			23
April 22.....	32.2	27.3	3.6	3.8			1.15		154			22
April 23.....	34.4	28.4	3.4	4.0			1.16	1.13	160			24
April 24.....	33.1	26.6	3.8	3.7			1.25	2.03	174			23
Average.....							1.27		172			25

^a Young joints not eaten not counted in average.

COMPARISON OF DIFFERENT PERIODS.

The following table shows the milk and butter yield of the different periods:

Period.	Cow No. 12.			Cow No. 13.		
	Feed.	Average daily yield of milk.	Average daily yield of butter. ^a	Feed.	Average daily yield of milk.	Average daily yield of butter. ^a
I	Pear and sorghum.....	37.6	1.68	Pear and sorghum.....	29.6	1.43
II	Pear.....	35.7	1.46	Pear.....	29.1	1.36
III	Sorghum.....	33.7	1.46	Pear.....	29.4	1.32
IV	Pear.....	33.5	1.43	Sorghum.....	27.6	1.24

^a In computing butter yield, 0.85 pound of butter fat is considered equal to 1 pound of butter.

If we compare an average of Periods II and IV with period III for cow No. 12 we have an average daily yield of 34.6 pounds of milk and 1.445 pounds of butter on pear, and an average of 33.7 pounds of milk and 1.46 pounds of butter on sorghum. In the case of cow

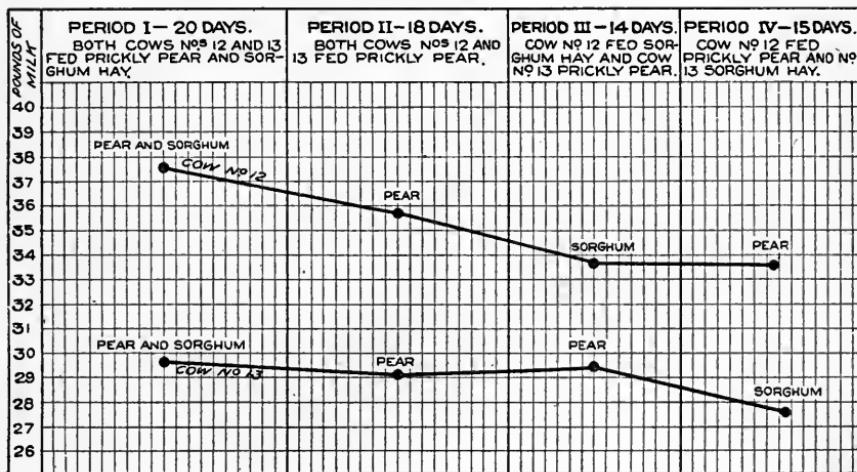


FIG. 1.—Diagram showing average yield of milk of Cows Nos. 12 and 13 during Periods I, II, III, and IV. The character of the roughage is indicated for each animal in each period. The scale showing the yield of milk in pounds per day is placed at the left. The small circles indicate the average yields for the periods. It will be noticed that the decline in yield, which is to be expected as lactation advances, is not quite so rapid on pear as it is on sorghum hay.

No. 13 the periods can not be so satisfactorily grouped to eliminate the effect of advancing lactation. The best comparison that can be made is between an average of Periods I and IV and II and III, when the record shows the following:

Average for Periods I and IV (sorghum mostly), 28.6 pounds of milk and 1.335 pounds of butter.

Average for Periods II and III (pear), 29.25 pounds of milk and 1.340 pounds of butter.

The relative milk flow can be appreciated more readily in the accompanying diagram (fig. 1).

The tables and the diagram show:

(1) Cow No. 12 shows a gradual decrease from a pear and sorghum ration in Period I to a pear ration in Period II, but not quite so rapid a decline as took place during Period III, when sorghum was fed. In Period IV, while a decrease is shown, it is less marked than in the preceding sorghum period.

(2) Cow No. 13 shows a slight decline in Period II and an almost complete recovery in Period III, but a sharp decline when sorghum is fed in Period IV.

(3) A full roughage ration of pear with a constant grain ration appears to yield fully as good results as a full roughage ration of sorghum hay. The records are really a little more favorable to the pear ration.

COST OF FEED.

It is impossible with our present imperfect knowledge regarding the rate of growth and habits of prickly pear under cropping conditions to make an estimate which is at all reliable regarding the cost of this item of the ration. In the computations, therefore, it is deemed best to omit the item of cost of producing the crop of pear. The estimates do not, therefore, contain any account of the use of the land upon which the pear is grown. At all events, this would be in accord with the general sentiment that pear costs nothing. This, of course, is not strictly true, although the rancher has as yet paid but little attention to prickly pear culture. He gathers it from his native pastures as he does his firewood. Upon this farm, however, a considerable effort has been made to propagate the plant, though the cost of the effort could not be estimated. The cost of the other items of the ration was as follows, the prices quoted being those actually paid upon the ranch during the time the feeding was in progress:

	Per ton.
Cotton-seed meal.....	\$22
Rice bran.....	13
Sorghum hay.....	7

One man can easily burn pear for 100 cows, and in addition he can assist in milking. He will use about 10 gallons of gasoline each day. During the past winter this cost 12 cents a gallon. The cost of a day's rations for each cow while pear without hay was being fed was as follows:

	Cents.
12 pounds of rice bran.....	7.8
3 pounds of cotton-seed meal.....	3.3
Labor.....	.75
Gasoline.....	1.2
Total.....	13.05



FIG. 1.—SOME OF THE BEEF CATTLE USED IN THE FEEDING EXPERIMENTS.



FIG. 2.—FIELD OF PRICKLY PEAR ON THE SINCLAIR RANCH.

This estimate is a trifle high, as it includes the cost of labor in excess of the time actually occupied in feeding. Thirteen cents a day will, therefore, represent very closely the entire cost of a ration as outlined above. When sorghum hay was fed in addition to the pear the cost of the feed was a little higher, but as hay was increased the cost of labor and gasoline decreased. It must be remembered, also, that the above estimate of 13 cents represents the maximum cost of the ration of the test cattle, and that the computation of the cost of feeding pear is based upon actual experience on the ranch during the past several years.

PECULIARITIES NOTED IN FEEDING.

On April 15 and 16, when cow No. 12 alone was on a full roughage ration of pear, it was observed that she left more than usual in the trough, although she seemed to relish the feed. This was at the time when young joints were first fed in any quantity, and it was soon discovered that it was pieces of these and not of the older joints that were left. After this the young joints were thrown out and no more of them fed during the remainder of the experiment. In the field cattle eat these young shoots readily in the spring, while they may not molest the older ones, but the reason is probably due to the condition of the spines alone. They would probably eat the older joints even more readily than the younger ones were they not so formidably protected.

The leathery texture of the young joints appears to be responsible for the fact that the cow refused to eat them when more palatable material was fed. All who have worked with prickly pear, especially botanists who have attempted to prepare specimens, have noticed that the young joints are very tough and leathery. Indeed, it is with considerable difficulty that one is able to split a young joint lengthwise with a knife, while the older ones are very easily cut.

It was a constant surprise to observe the fondness of the cattle for the singed pear. During the latter part of the first period the temperature was unusually low for southern Texas. The United States Weather Bureau records show a maximum of only 35° and a minimum of 13° F. on February 13. It will be seen that a little extra sorghum hay was fed on this day. Regardless of the fact that the pear was frozen solid all day the cows ate 90 and 92 pounds, respectively. This was the coldest day of the winter, but not the only day when the cows ate frozen pear with apparent relish.

CONDITION OF THE ANIMALS.

The distance of the ranch from any convenient means of weighing prevented the securing of data on the important point of the weight

of the cows, but careful observations were made by several individuals, both those having immediate charge of the animals and those who saw them only occasionally. All agreed that the condition of both cows continued to improve up to the end of the experiment.

Of course, the well-known laxative effect of prickly pear was evident during the entire time that it was fed, being less noticeable while sorghum was a part of the ration; but at no time was it thought that the cows scoured to any injurious extent, even during the period when pear was the only roughage fed them. The fact that they apparently gained in flesh, milked well, and began shedding earlier than the general herd appears to be sufficient proof that they were in good physical condition during the entire period.

INFLUENCE OF PEAR ON QUALITY OF MILK.

The statement has frequently been made that the quality of milk is injuriously affected when pear is fed to dairy cows, and it seemed important to secure data on this point in connection with this experiment. Mr. Sinclair has fed pear to his herd for two to four months each year for six or eight years, and no complaint has ever been received from customers which could in any way be attributed to pear feeding.

During the time when one of the cows was on a full roughage ration of pear—that is, on rice bran, cotton-seed meal, and pear with no sorghum hay—five persons tested the milk to determine whether any odor or flavor was imparted by such a ration. Morning's milk was examined in the evening with the result that four persons could not detect any change, deleterious or otherwise, while one was in doubt.

PRICKLY PEAR IN RATION OF BEEF CATTLE.

CONDITIONS OF THE EXPERIMENT.

As stated previously, an effort was made to keep the steers fed in the beef experiment under conditions as nearly similar to those prevailing in the general pear-feeding region as possible. The steers selected were from the general Coleman herd, a miscellaneous lot, a majority of which were bred near Cactus, Tex. They were considerably above the average of the cattle in the neighborhood, or even on Mr. Coleman's ranch. (See pl. 2, fig. 1.)

The intention was to feed one carload (20 head) of steers, but when the animals were gathered 27 head were weighed and put in the pen. The additional 7 head were not removed until the close of the experiment, but only the original carload of 20 head was shipped at the close of the feeding, the others being shipped with a miscellaneous lot of cattle to another market.

The feeding lot was an ordinary open mesquite "trap," containing approximately 4 acres of ground, and inclosed by a wire fence. No shelter of any kind was furnished the cattle. The scrub mesquite brush in and surrounding the feed lot offered very little protection. This might not be a serious consideration in an average southern Texas winter, but during the past winter protection would have enhanced very considerably the gains made.

METHOD OF FEEDING.

The method of feeding in this case was exactly that employed throughout the pear region of Texas wherever the pear chopper is used. The largest and most woody plants available were used, from localities where the growth was most vigorous and healthy. They were chopped with one of the common pear choppers, but without singeing.

In this experiment the feed was gathered from the field twice each day—at about 7 o'clock in the morning and 3 o'clock in the afternoon—cut, and fed immediately. The chop was shoveled into the ordinary feeding troughs, and the cotton-seed meal was sprinkled upon it in such quantity as would give the desired number of pounds for each animal.

With this method of feeding it was not feasible to furnish more pear than the animals would eat, because of the necessary waste of meal, but a constant effort was made to give them all they would clean up.

WEIGHING.

Although the steers used were probably more gentle than the average stockers of southern Texas it was found impracticable to secure weekly weighings, as was the intention in the beginning. The two weighings that were made, it is believed, cost the gains of an entire week. All the animals became considerably excited, and once or twice threatened to stampede.

On account of the apparently good gains being made by this lot of steers Mr. Coleman decided to put another herd of 100 head on feed in an adjoining pen. At first these also did very nicely, but they soon became wild, with no apparent cause, and it was decided to turn them out into pasture again.

The experimental lot did not get nearly as wild as the others, even with the weighing, but there is no doubt that the final gains were very materially reduced by the excitement caused during the weighing. It should be stated that the greatest care was exercised by Mr. Coleman in the handling of these steers during the entire period. Aside from the necessary handling and weighing they were subjected to no circumstances to excite them.

SHIPMENT AND SALE OF STEERS.

On the evening of April 28 the final weighing was made and the steers, after receiving about a one-half ration on the morning of April 29, were driven into the stock pens at Encinal and loaded into a car. They did not leave the yard, however, until the following morning. They were consigned to Fort Worth, where they were sold at \$4.25 per hundredweight on a break in the market on May 2. The account sales showed 21,560 pounds to be the weight of the 20 steers, giving a loss in transit of 1,770 pounds, or 88½ pounds for each animal. This shrinkage is not considered excessive by Mr. Coleman, whose records of shipments from the ranch during past years are probably not exceeded for accuracy by those of any ranch in Texas. In some shipments the shrinkage has been greater and in others less than in this instance in the case of steers shipped off the range.

THE FEEDS USED.

The following table shows the kinds and quantities of the feeds used by periods:

Date.	Days in each period.	Total pounds of pear.	Average pounds of pear per head per day.	Total pounds of cotton-seed meal.	Average pounds of cotton-seed meal per head per day.
Jan. 15-Jan. 21.	7	16,890	89.36	220	1.16
Jan. 22-Jan. 28.	7	17,567	92.94	300	1.59
Jan. 29-Feb. 3.	6	15,195	93.79	350	2.16
Feb. 4-Feb. 10.	7	18,345	97.06	700	3.70
Feb. 11-Feb. 17.	7	15,625	82.67	700	3.70
Feb. 18-Feb. 25.	8	20,395	94.42	800	3.70
Feb. 26-Mar. 4.	7	19,040	100.74	1,050	5.55
Mar. 5-Mar. 11.	7	19,655	103.99	1,050	5.55
Mar. 12-Mar. 18.	7	19,975	105.69	1,050	5.55
Mar. 19-Mar. 25.	7	19,315	102.19	1,050	5.55
Mar. 26-Apr. 1.	7	18,840	99.68	1,050	5.55
Apr. 2-Apr. 8.	7	18,715	99.02	1,050	5.55
Apr. 9-Apr. 15.	7	18,850	99.74	1,050	5.55
Apr. 16-Apr. 22.	7	19,175	101.45	1,050	5.55
Apr. 23-Apr. 28.	6	16,275	100.46	900	5.55
Apr. 29.	1	2,100	77.77	80	2.96
Average.			96.31		4.31

GENERAL OBSERVATIONS.

In spite of the very unfavorable weather, and adverse conditions generally, the gains made were comparatively satisfactory. Of course the gains were not as great as those of stall-fed cattle, nor even those obtained in the older and better established feeding sections. However, the cost of a pound of grain, computed from the above tables and data, is more favorable to the combined cotton-seed meal and prickly-pear ration than one unfamiliar with prickly pear as a roughage would suppose. On an average 77.6 pounds of prickly pear and 2½ pounds of cotton-seed meal produced 1 pound of gain;



FIG. 1.—MACHINERY READY TO CHOP PEAR.



FIG. 2.—CHOPPED PEAR READY FOR FEEDING, ON THE COLEMAN RANCH.

or, in actual outlay of cash for feed at the prevailing price for meal of \$23.75 per ton, 1 pound of gain cost 2.97 cents' worth of cotton-seed meal, which is not at all excessive for the cost of grain to feed with pear.

The cost of labor can not be accurately determined for this experiment because of the small number of animals which were fed, but the data furnished here, together with the experience of Mr. Coleman and others in feeding pear during the past ten years, enables one to make a very close estimate of the necessary expenses. The actual conditions were that one man did all of the feeding during the entire period, and was assisted in the chopping by three other men—an engineer and two laborers. He in return assisted them in chopping two loads for each one that he used, and their loads represented about 50 per cent more pear than his. All pear was hauled an average distance of 1 mile, and each load was weighed on the way from the field to the chopper, necessitating a little extra travel. While all that was required of the man in charge of the feeding was the care of these animals, his time was not entirely occupied. Indeed, it is believed he would have had little difficulty in feeding 100 head under these conditions. In actual practice much less labor would be required, both on account of greater convenience in feeding and greater economy of time.

In Bulletin No. 74 of the Bureau of Plant Industry estimates are made which indicate that eight men can feed a maintenance ration to 1,200 head of cattle. Reducing this number to the extent necessary to compensate for the additional care required in the feeding of a fattening ration, it is estimated that eight men could without doubt feed 1,000 head of cattle. Assuming the figures of cost in the publication mentioned to be correct, the total expense of labor, gasoline, and interest on machinery would be in the neighborhood of 90 cents for each animal for a period of one hundred days.

The value of the pear is not included in this estimate, and, as in the previous experiment, it was not possible to determine its cost. Should one ask a rancher in southern Texas to estimate upon this point, his answer would invariably be, "Nothing." In fact, it is questionable whether the pastures are not actually improved by cutting off the older, larger plants. As in all fattening experiments, the increase in weight alone does not represent the entire gain; the improvement and enhanced valuation of the whole carcass must be taken into consideration, but all of the estimates are based upon value of the increased weight alone.

The relation of gain to feed consumed may be summed up as follows:

1. Average daily ration of pear for each head of stock, 96.31 pounds.

2. Average daily gain for each head, 1.75 pounds.
3. Amount of pear fed for 1 pound of gain, 55.03 pounds.
4. Amount of cotton-seed meal required for 1 pound of gain, 2½ pounds.
5. Cost of cotton-seed meal for 1 pound of gain, 2.97 cents.
6. Cost of pear per 1 pound of gain 0.514 cent.
7. Cost of feed per 1 pound of gain, 3.48 cents.

THE NATURE OF CHOPPED PEAR.

Since many erroneous statements have appeared regarding the nature of pear chop, and since the publications of the Department on the subject have been misinterpreted, this seems to be a fitting place to put in a few words of explanation regarding the work of the pear chopper and the character of the feed produced.

A description of the pear choppers is given in a previous bulletin^a and need not be repeated here. (See also pl. 3, fig. 1.) The construction of the machine indicates that the pear may be reduced to very fine consistency. But pieces 6 inches square may be found in the chop when ready to feed. Plate 3, figure 2, shows this condition fairly well. The material is there represented in the rear end of a wagon as it was thrown out of the machine by the centrifugal force of the revolving wheel (pl. 3, fig. 1). Large pieces are shown; but no special injury to the cattle was observed from feeding them. It is evident that all pear joints fed to the machine at right angles to the knives, as described in the publication referred to above, will be cut into pieces $\frac{1}{2}$ to $1\frac{1}{2}$ inches in length, depending upon the setting of the shear plate; but whatever material happens to be fed in such a way as to reach the machine in the plane of the knives will pass through in large flat pieces. Often a piece of joint 4 to 6 inches square, or even a whole joint, will pass through the machine with practically an uninjured epidermis. The material never is macerated or reduced to a pulp. In spite of this, however, little or no evil effect results from the spines, even in the case of joints which pass through the machine uncut. The dead and exceedingly brittle spines have invariably received enough rough treatment in passing through the machine to reduce very perceptibly the injury which they can do. There is no denying the fact that stock which are fed pear chopped in this way are somewhat annoyed by the spines. There is always more or less slobbering as the result of the spines sticking into the membranes of the mouth, but the effect does not appear to be a serious one.

It has been frequently stated that the spines are softened by the juices of the plant in the chopped material to such an extent as to

^aBulletin No. 74, Bureau of Plant Industry, p. 17, Pls. II and III.

render them innocuous—an idea which is entirely erroneous. It is always the practice to feed immediately after chopping. Indeed, it is doubtful whether the spines would become very materially softened before the chop would ferment to such an extent as to render it unfit to feed. The effect upon the spines is entirely one of abrasion; they are broken to such an extent that the injury they cause is very much reduced. Cattle can handle pretty rough feed, and they eat much of the Texas pear as it stands in the pastures. It is believed that if the spines lay tightly against the surface of the joint, instead of approximately at right angles to it, the cattle could graze the pear with but little difficulty. It should be emphasized that in pear chopping the spines are not softened by the juices and the material is not macerated, but that the chances of the spines doing injury are reduced to a minimum by the rough treatment which they receive from the machine. It is also evident to anyone watching the operation of a pear machine that many of the spines are winnowed out and removed from the product during the process of chopping.

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